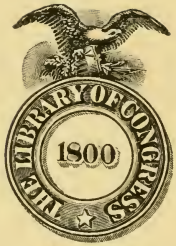
The Inductive Determination of Educational Methods

Ambrose L. Suhrie



THE INDUCTIVE DETERMINATION OF EDUCATIONAL METHOD

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OR

The Standardization and Application of Efficiency Tests to Any of the Numerous Factors of Educational Method Which Now Dominate Class-Room Teaching Processes or Which May Be Made to Contribute to Their Greater Efficiency

BY

AMBROSE L. SUHRIE

Professor of Pedagogy, State Normal School, West Chester, Pennsylvania
and
Special Lecturer in Educational Research in the Summer School of the University of Pennsylvania

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INTRODUCTION BY

A. DUNCAN YOCUM

Professor of Educational Research and Practice, University of Pennsylvania,

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To

LINCOLN HULLEY, PH.D., LITT.D., LL.D.
President John B. Stetson University

EDUCATOR
Friend and Inspirer of Youth

PREFACE

As a member of a seminar in Education working for some time under the direction of Professor Yocum at the University of Pennsylvania in the particular field of research treated in this monograph the writer was much impressed with the need of a brief treatise clearly setting forth, in lieu of a series of introductory lectures, some of the objects which might be pursued and some of the methods which might be followed by similar groups of collaborating scientists in the field of educational methods.

It is hoped that this specific purpose may be served by Professor Yocum's brief introduction to this study and by my own more fully-developed outlines.

The complete manuscripts of my more extended study in this field will hereafter be available to students in the library of the School of Education at the University of Pennsylvania, Philadelphia.

Ambrose L. Suhrie.

State Normal School,
West Chester,
Pennsylvania,
September 1, 1914.

INTRODUCTION

By A. DUNCAN YOCUM
University of Pennsylvania

INTRODUCTION

Just as surely as Psychology has been transformed from a philosophy to a science, Education is working over from a deductive to an inductive basis. In the field of administration the change has been so marked that most educational thinkers no longer test a school system through the extent of its agreement with some theoretical scheme, but rather through the presence or absence of those features which research finds common to all successful systems. To be sure, in most efficiency tests there has not been sharp distinction between favorable conditions, essential factors, and ultimate facts, but, that efficiency is being measured in more or less scientific fashion, median and graph bear eloquent testimony.

The science of school administration, however, cannot be adequately built up until research and experimentation in the field of instruction, both as distinct from school supervision and management and as a part of it, has developed a science which is determining for both course of study and methods of teaching.

Dr. Suhrie's thesis, of which the present monograph is the introductory part, is a highly useful contribution to this latter phase of investigation. Most experiments in methods of teaching the various

school subjects have been either so loosely conducted or imperfectly reported that their results are not scientifically valid. While Dr. Suhrie's mode of procedure need not be precisely followed, none of the steps which he has enumerated can be safely omitted if the results of investigation are to win universal acceptance and to dominate the processes of instruction with a sterner compulsion than that of tradition or authority.

In emphasizing mode of procedure, however, one thing must be held clearly in mind. Mode of procedure is merely a means to an end. No precautions to ensure unvarying conditions or statistical treatment of results can make conclusions educationally valuable if the thing tested is not an actual factor in some specific process of instruction, and if more than one factor is varied in the experiment. For example, demonstration of the fact that the pupils in a particular school grade are predominantly eye-minded does not prove that the spelling lesson should be mainly visual, but merely points the way to the determination of the effect of visual presentation upon the memorizing of particular lists of words. Such a determination might prove it to be effective for polysyllables or words largely unphonetic without being helpful to phonetic monosyllables, or economical in memorizing, but fatal to comprehension or to the development of ear-mindedness and the power of carrying over a particular sequence of letters to all parts of words which have a corresponding

sound. That is, experimentation must be preceded by analysis which limits the test not only to a particular factor in method, but to a particular sort of material and a particular kind of efficiency. On the other hand, however specific the factor, material, and efficiency that are tested for may be, if more than one factor is varied, the result is inconclusive. A test to determine the effect of visual repetition in the memorizing of particular sorts of spelling words is valueless if the visual presentation follows an oral one without compensation being sought for the additional repetitions involved. Any gain in efficiency may have resulted as certainly from the additional repetition of the oral spelling as from the additional visual repetition. The problem of method is not the comparative efficiency of Miss So-and-So's system of teaching reading with that used in some other series of textbooks. All methods of teaching the same material, or developing the same sort of efficiency, must have most factors in common; but every little shift of the kaleidoscope puts them in new combination and creates a new "method" to compare with the old. The true problem of method is the determination of the relative efficiency of each specific factor, whether it is the unique feature of some one method or a common factor to all.

Once determine, for example, the kind of grouping by similarity that is most effective for each sort of geographical subject-matter, with a view to each kind of geographical efficiency, and range all other

forms of grouping in the order of their relative efficiency; perform the same task for all other factors, such as form of presentation, interval in repetition and gradation, and the problem of efficient geographical instruction is solved. The most effective method for the majority of pupils can then result from putting togther into one combination all of the relatively more effective factors that are not mutually exclusive; the value of any particular method or textbook can be determined by the presence or absence of such factors; and the method adapted to a particular individual can be chosen through the use of the most effective factors which his personality does not render inoperative.

Complex as this task appears when one considers the multiplicity of subjects and variety of subject-matter, and the numerous kinds of efficiency and factors in method, it is simple when compared with the formulation and combinations of such a science as organic chemistry. If I can judge from the limited response to inquiries I have recently made through various professional periodicals, and constant effort to gather together reports on experiments in this field, little has as yet been accomplished. Such a system of reports as has been planned by the Society of College Teachers of Education, the work of such committees as that recently appointed by the Council of Teachers of English, and, above all, the multiplication of monographs such as this, will sooner or later have the effect of

creating an adequate body of expert educational workers for this field of service in which Dr. Suhrie and other members of my Seminar have been doing pioneer work.

A. Duncan Yocum.

THE INDUCTIVE DETERMINATION OF EDUCATIONAL METHOD

The Inductive Determination of Educational Method

OUTLINE

I. Introduction.

II. The Scientific Educational Society.

III. The University Seminar in Educational Research.
   1. General conditions of membership.
   2. Types of specialists needed.
   3. Meetings for round-table discussion.
   4. Division of labor.
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IV. The Work of Scientific Experimentation in Educational Method.

V. Outline of Considerations and Suggestions for Inductive Determination of Educational Method and for Effective use of Conclusions.
   1. Formulation of problem for experimentation.
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4. Development of procedure for experiment.
5. Conducting of experiment.
6. Review of experiment and preliminary report.
7. Formal report and publication.

VI. Development of Outline.
(In which sections designated a, b, and c correspond in each case to the two or three subdivisions under each of the seven subordinate headings in outline V above.)

I. Introduction

Preliminary to a consideration of the question of procedure in the inductive determination of educational method, it may be well, for reasons which are practical rather than theoretical, to consider the agencies through which educational scientists may, by combining their efforts, best attain to useful scientific achievement.

II. The Scientific Educational Society

Schleiermacher thinks that in the very need of science there is need of the scientific society. Whether or not this be true of science in general, it is obviously true of the need which is at once suggested by any constructive efforts to develop a science of education on an inductive basis. Any real achievement in the domain of scientific educational method must come as the result of wide collaboration—this because of the complex character of all its inter-relationships and the number of contributing sciences which furnish much of the data, and because of the traditional and unscientific attitude of many otherwise scientific men toward this particular branch of human interest.

Conradi has summarized the remarkable contributions to the advance of experimental science (see article under title "Learned Societies and Academies

of Early Times'' in Pedagogical Seminary, Vol. XII), in many lines of human interest, made by the collaborative efforts of the great independent thinkers who formed the learned societies of ancient times. His conclusions, after an extended study of the subject, are that these men and their scholastic successors on down through the Middle Ages, when free thinking was proscribed, accomplished more by co-operation and collaboration as organized bodies of workers, often in secret research, than all other agencies combined, to advance experimental methods of investigation, to keep the idea of finality out of science, and to develop the concept that scientific accuracy is always relative and never, not even in the domain of the pure sciences, absolute.

The pessimistic philosophy of the East, which virtually denied the improvability of the human race by the processes of education, dominated the Christian world for long centuries after the fall of the Roman Empire. Men thought of education as a conserving art; they did not see in it a dynamic force for human betterment. Little wonder, then, that the learned societies should have almost completely neglected the study of educational data and that these data should constitute the latest considerable body of facts of intensely human interest to take on even the semblance of scientific form.

It is one of the hopeful signs of the times that scientific educational societies are becoming more numerous and selective, and that many types of or-

ganization have in recent years come into existence, and that so many objects, both general and special, are pursued (see Alexander's volume on "Teachers' Voluntary Associations," Teachers' College, New York). These societies, by whatever names they may be known, which include among their membership groups of individual workers absolutely willing to resubmit to scientific test all the premises upon which contemporary educational theory and practice rest, can do, and, it is believed are doing, more than any other equal number of independent workers to overthrow the rule of the dogmatists, still enthroned in our educational system, whose mere opinion, resting on no basis of scientific fact, often receives wide acceptance because of successful administrative achievement or forceful and dominating personality.

Unfortunately, however, eligibility for membership in these societies is not, in most cases, clearly determined on the basis of scientific training for any specific function to be performed in a work of collaboration. Many of these organizations are very large and their membership composed, for the most part, of the relatively untrained. The chief services which such societies can render must, for obvious reasons, be to develop a scientific attitude of mind toward the investigation of educational problems and to disseminate widely a knowledge of the valid results of experimentation carried on by smaller bodies of more expert educational scientists. To

push out the boundaries of scientific exploration in the domain of educational interest is the work of those who have had broad general training and some practical experience in educational research and experimentation, and who are organized in groups of workable size.

III. The University Seminar in Educational Research

It is believed that if any substantial, not to say rapid, progress is to be made in the inductive determination of the numerous factors in educational method, in the evaluation of their relative importance, and in the co-ordination of all these results into well-organized educational principles, capable of specific application to the procedures of classroom teaching, it will probably come chiefly through the scientific contribution of such agencies as the University Seminar in educational research. With the more liberal endowment of universities and teachers' colleges for purposes of specific educational investigation, with the granting of more numerous and more substantial working stipends to educational scientists of good training, wide experience and mature judgment who wish to retire temporarily from active educational work to pursue, with undivided attention, investigations of real significance to educational method, with the better facilities which the United States Bureau of Educa-

tion, the State Departments of Education, the Carnegie Institution, and other educational foundations are providing for the publication and free distribution of reports of scientific interest in the field of education, it is perhaps safe to predict that in the near future these University Seminars in educational research will be more numerous, that they will be composed of a more selective membership than any of the more general educational societies, and that they will assemble for more permanent labors under conditions more favorable to productive collaboration than any other body of scientific workers now engaged in the solution of problems of scientific educational readjustment.

It is not here contended that the educational investigator of widest and most helpful experience in educational work and of most complete scientific training will always be most readily available for membership and participation in the work of University Seminars for educational research, nor that the only important contributions will come from these groups of associated scientific workers. The conditions are likely, however, to become increasingly favorable to both these results. Since the opportunity of the University to do constructive educational work and to render eminently useful service through these agencies must be evident to all who have caught the scientific spirit in education, the imperative duty of the University authorities to adopt a policy and to formulate a working program ought

to be equally obvious. Any effort now to formulate such a policy and to construct such a working program will be timely, and if it should prove to be only suggestive, it may, to that extent at least, be constructive and helpful. It is, therefore, attempted. The work of a University Seminar in educational research along the line of the specific application of general educational principles to classroom teaching processes will, of course, be a highly-specialized type of advanced graduate study and investigation.

1. General Conditions of Membership. Membership in one of these groups which aims "to see the devious ways of induction" in a very difficult field of investigation and to make a real contribution to the science of educational method should presuppose and be conditioned on a broad knowledge of the general sciences, a thorough training, on the inductive basis, in general, genetic, and educational psychology, some practical experience in teaching under ordinary classroom conditions, a good general knowledge of the theories underlying statistical methods, together with some practical experience in making statistical interpretations, and a familiar acquaintance with such approved scientific study in the field of inductive educational method as have been published. This much training ought to be considered a minimum prerequisite on the part of any who desire to participate intelligently and profitably in the labors of the group, and to contribute to its

scientific achievement. With less than this the members of such a group of research workers, or associated educational scientists, may not hope to easily gain common concepts in a scientific discussion or to assist in that minute analysis which is essential to the isolation of factors in educational method. For them, too, the formulation of the procedures necessary to a scientific test or the framing of valid conclusions on the basis of data collected must be out of the question.

2. Types of Specialists Needed. It is believed that in something like exact proportion to the degree in which a seminar contemplating research in educational method can be recruited from scientific workers whose technical training has, at least in some one direction, gone beyond these minimum general requirements may it hope to push investigations further than anything yet attempted, and, by refining the analysis of the factors of method and better controlling the conditions of experimentation, to overthrow existing inefficient practice or to modify it or to give complete confirmation to the tentative conclusions now held as the outcome of experiments made and results published.

A good working group, in whose discussions all may freely participate, must, for obvious reasons, be of limited membership. The best possible contribution which individual members may make to a scientific discussion will frequently take the form of perti-

nent, timely and well-defined questions or suggestive comments. If the group is too large to assemble for informal round-table discussion the danger is that the interests of science may have to yield place to the flow of oratory. In order that the contributions of each to the work of the group in its formulation of problems preliminary to actual experimentation may be technically pertinent, highly analytic, genuinely scientific, and constructively helpful, it would seem well—since the group must be limited in numbers—to include in the membership of the seminar, whenever possible, men who, in addition to the prerequisite general training enumerated above, represent each in turn a high degree of specialization in one or more of the sciences from which we get important data of educational interest and significance. To illustrate:

a. *The psychologist.* The counsel of an expert psychologist is indispensable in the analysis of factors which contribute to sense perception, to temporary or relatively permanent recall, and to the easy and certain formation of habits as well as to the scientific delimitation of a score of other psychological factors which must be taken into account in determining even tentatively whether or not in the test of a given procedure in method we are dealing with a psychological complex. Then, in the study of data collected, preliminary to any attempt at statistical treatment and interpretation, the ex-

pert psychologist may identify atypical students whose failure to respond in a normal way and within reasonable limits of individual variation to a given group procedure, may not condemn the procedure as a teaching process for class use, but rather indicate that these students need special treatment, and that the data gathered by the testing of them should, for obvious reasons, not be included in statistics which are to be made the basis for conclusions on normal classroom methods. Then, too, the expert psychologist, by reason of his extensive training in and habitual use of the inductive method in laboratory work in the investigation of many forms of psychic reaction, can more readily than most others decide from internal evidence to be found in papers submitted or in data collected by other means whether the experimenter, working under the direction of the seminar, has really maintained all the conditions of experimentation agreed upon in advance as prerequisite to valid results.

b. *The school supervisor.* The counsel of an expert and experienced school supervisor is indispensable in determining the groups of students or classes or schools in which a test may be made and the conditions under which it may be made with any reasonable hope of scientific results at all commensurate with the efforts expended upon it. Years of experience and close observation of the work of many teachers in all of the school grades with widely-

differing types of students and under all sorts of varying conditions have given him a perspective in the teaching processes and a power of ready analysis of the conditions under which and the extent to which an *a priori* educational principle can be applied not possessed by the teacher whose experience has been limited to classroom work and certainly not possessed by those who have not had any practical experience at all in actual teaching. Like the trained psychologist, he, too, can give expert opinion, based on internal evidence, in papers scored or data recorded, as to whether or not varying factors have been adequately guarded against in the carrying out of the procedures of experimentation.

c. *The sociologist.* The counsel of a trained sociologist, or social psychologist, may be invaluable in locating characteristic types of students for various forms of experimentation. He may also point out important and characteristic distinctions which might introduce varying factors in a given group procedure, due to race or social group differences. And, in interpretating data collected, his clear concepts of group types may enable him to formulate theories of possible inductions which would not occur to the mere statistician with a mass of tabulated data before him in the form of crude statistics. And, as is often the case with other lines of scientific investigation which are dependent upon the possible legitimate uses of statistics, it may happen that his

"guess" as to the correlations which exist will open the way to scientific discoveries of real importance, and in this case of wide significance to educational method.

d. *The statistician.* The counsel of an expert statistician is indispensable at almost every stage of the proceedings. His advice will be definitely helpful in formulating the tests and the procedures of experimentation on such a basis that the results may admit of statistical treatment and thus yield quantitative as well as qualitative conclusions. If he has participated in the formulation of a test and in the working out of a procedure for experimentation and has been in close touch with the experiment in progress and has followed with keen interest every record of varying conditions favorable or unfavorable to the validity of results sought, he, of the entire group of scientific workers, will be most likely, by reason of the special character of his training, to be able to work out all the legitimate conclusions warranted by the statistical data collected. Upon the completeness of this rests the possibility of rapid scientific advancement by the statistical method of inquiry. The perverted uses of statistics are proverbial. Unless the scientist who makes interpretation of statistical data collected from these tests has participated in the formulation of the problem to be tried out, there is danger, no matter how thorough his technical training may be, that he may make sum-

maries not fully warranted by the data simply because he does not know the full significance of these data from the standpoint of educational method.

The services of the expert statistician are indispensable for a better reason than any yet given. The higher mathematical calculations involved in the working out of correlations, etc., and in the whole statistical treatment of data are such as call for the labors of a specialist in that line and much would be gained in the development of a science of education if these studies in scientific educational method could be prosecuted only by groups of collaborators all of whose members had had this special technical training in mathematical computation.

These are merely types of specialists—the list is not exhausted—who as members of a seminar in educational research may, in framing a problem in educational method, in deciding upon the procedures of a test, and in interpreting the data collected, render most valuable services and sometimes give expert direction absolutely indispensable to the validity of results sought in experimentation.

Any amount of technical knowledge, training, or skill on the part of individuals or the group as a whole will not, however, serve the interests of educational science if there be any disposition "to entertain a proposition with greater assurance than the proofs it is built upon will warrant." It is believed that the educational seminar whose membership is constituted as above suggested on a defi-

nitely selective basis, furnishes, in the very nature of its organization and of its methods of collaboration, the best possible safeguard against an unscientific and biased attitude of mind on the part of those whose counsels will prevail in the formulation of tests in educational method and whose services will contribute directly or indirectly to the results wrought out and the conclusions arrived at in the course of inductive scientific inquiry. Technical training in the use of the inductive method and a scientific attitude of mind are not, however, substitutes for each other. They are complementary, and both are alike indispensable to the validity of scientific conclusions sought in the test of the factors in educational method. Against the bias of individual viewpoint, due to limited experience, partial knowledge, or personal prejudice, collaboration must serve as an effective and constant corrective. From what has been said up to this point the conclusion is easily drawn that in the judgment of the writer the seminar in educational research may be made the most effective body of educational scientists to advance the boundaries of our definite knowledge of educational method, and that it is justified on grounds of expediency, economy and efficiency.

3. *Meetings for round-table discussion.* In order to maintain the continuity of work while problems are in process of definition and while procedures for experiments are being formulated, it would doubtless

be well that conferences of two or three hours duration be held at intervals of a week, or not longer than two weeks. While the experiments are being made it is almost equally important that meetings or conferences be held frequently, so as to note and make full record of all varying conditions which may not always be controlled, but which must be taken into account as reinforcing or interfering with the validity of results. While the data gathered in an experiment are being analyzed, classified and worked up for statistical interpretation, and while the formal report on conclusions is being drafted by some individual or committee designated to do so, there is less need for frequent or prolonged conference unless requested by the person or persons directly in charge of this work. The task will be less onerous and the final report to the seminar will be less likely to need important revision if stenographic notes on all previous discussions of any and every phase of the investigation are available to the member or members designated to draft the report for publication.

The discussions of the seminar in session must necessarily be more or less informal, but should not, and need not, lack definite direction. The specific purpose of the discussions on any investigation proposed, or being made, may, perhaps, best be accomplished under the leadership and direction of the member in active charge of the problem or the experimentation. This is sure to be the case when such

member is an experienced investigator. All sessions may well take on a quiet and judicial atmosphere. There must be no dominance of personality to prejudice a decision. Arguments must be freely set forth, objections clearly stated and supported, when possible, by illustrations from personal experience or reference to published scientific authorities, and all contentions and objections, well supported and judicially weighed, should be freely granted.

4. Division of labor. As to the division of labor, there are several courses open:

a. The group as a whole may confine its labors to the investigation of a single problem, each individual member contributing to its delimitation and to the formulation of the procedure of the experiment, and personally devoting some time to conducting the experiment with a group of students or in a number of schools—thus enabling the seminar, by the collaborative efforts of all of its members, to utilize very large numbers of students in the experiments. This, of course, will have a tendency to increase the validity of conclusions reached. This method of cooperation in the work of experimentation has its advantages and its disadvantages, which vary, of course, with different types of experiments undertaken.

b. Each individual member of the seminar may report on a different investigation, and each may, after full discussion of his special problem in the seminar, conduct an experiment under the direction

of the group, work up the data, and formulate the conclusions.

c. The seminar may resolve itself into a company of expert advisers who meet periodically for consultation with an investigator who devotes his entire time under their advice and direction to the investigation of a single problem in educational method.

d. A combination of any two, or of all three, of these methods of apportioning the tasks of productive collaboration may be adopted. The expediency of adopting this plan or that one will be determined by the personnel of the seminar, by the time at the disposal of individual members, and by the accessibility or inaccessibility of student groups or schools available for, and adapted to, purposes of experimentation, as well as by numerous other considerations which cannot easily be anticipated.

5. Field of investigation. As to the field in which experiments may be conducted, each seminar has a wide range of choice:

a. It may select some general and more or less universally accepted principle of educational method, and, with no foregone conclusions as to its scientific validity, try it out in a series of tests applied to the several school subjects and in the several grades. This work, if well done, with a sufficiently large number of students as subjects of experimentation, will be likely to yield fairly conclusive results of a positive or of a negative character. If the results are

positive, then the distribution of results and the variation in different school systems, in different race or social groups, at different school ages, etc., will throw much light upon the conditions under which and the extent to which these *a priori* educational principles are in practice applicable. If the results are uniformly negative, then the way has been opened for the superseding of traditional methods by others which will eliminate waste and yield a larger degree, if not a maximum degree, of educational efficiency; and whether the results be positive or negative, if they are at all conclusive either way, the reign of the dogmatist in the domain of educational method and in the field covered by the investigation will be at an end.

b. The seminar may select all so-called principles of method from whatever source derived, which are said to have bearing, direct or more remote, on the teaching of a given school branch of study—say spelling—and formulate the problem of each for experimentation. The practical results for scientific educational method will be virtually the same as those indicated above.

For practical reasons, it is well that the seminar should limit definitely, by some well-defined principle of choice, the field of its investigation. The development of a science of educational method on an inductive basis will ultimately involve an approach to the general problem from many different directions, and the final co-ordination of all results into a

scientific unity. This will represent the final stage of a process which has been but begun. Until the number of educational seminars greatly increases and the procedures of investigation come to be much better developed, there is little danger of wasteful duplication of effort. When a little more substantial achievement has been made in this field, the United States Bureau of Education or some scientific society, international in its constituency, should serve as a clearing-house for the wide publication of such scientific discoveries in educational method as have been made, and the time may come ere long when some such general agency as has been referred to may, with propriety, undertake to formulate the whole problem of educational method and assign to groups of associated scientific workers special fields for investigation, to the end that we may ultimately have a complete inductively determined science of educational method. At the present time, however, any seminar group desiring to make an original contribution to this end has practically a clear field of choice for useful service.

IV. The Work of Scientific Experimentation in Educational Method

When a desirable and adequate membership has been secured, a principle for the division of labor has been agreed upon, and a specific field for investigation has been selected, the group is ready to formu-

late a problem in method and to work out in conference a procedure for scientific experimentation. Very little has as yet been done to develop any general or specific formula for experimentation in the field of educational method, and there are really no good published authorities on the subject. Fragments of suggestions of the procedures adopted by individual experimenters are to be found in the published reports of experiments made in this field. Many of these will not furnish safe models for future use, since they neither delimit a problem to a single factor in method nor adequately safeguard the conditions for uniform experimentation with anything approximating the complete elimination of varying or disturbing factors. Any one of these studies,—or all of them taken together—is far from completely suggestive of the steps which must be taken in working out, with scientific exactness, the test of a difficult or complicated problem in educational method. Inasmuch as every problem open to investigation is closely related to many others, and, since every step in the procedure of a test is likely to be closely dependent on every other one involved in the same piece of experimentation, it may be well that a full view of as many of these inter-relationships be presented to the mind at one time as possible. An outline is, therefore, suggested to indicate roughly what is involved in delimiting a problem for experimentation, in developing a procedure to be followed in conducting the test, in making the specific application of

this procedure to concrete classroom conditions, and, finally, in working up the results for publication in such form as will render the conclusions broadly significant to educational scientists and clearly intelligible to all who desire to improve their actual teaching by bringing their practices into conformity with well-demonstrated principles of scientific educational method.

It is not intended that this outline should suggest the order of importance of the topics set down for deliberate consideration, nor even the order in which they may to best advantage be discussed and determined; and it is certainly not intended to attempt to make a complete enumeration of all the topics which will call for consideration in connection with even the simplest piece of experimentation. The bare outline, in its briefest form, without any attempt at development, is here given, so that it may be printed in the least possible space for ready reference. Some comments in the nature of explanation and elaboration will follow this.

V. Outline

Of considerations and suggestions in connection with any investigation undertaken for the inductive determination of educational method and also in connection with the effective use of such conclusions as may be reached for the improvement of teaching procedures:

1. FORMULATION OF A PROBLEM FOR EXPERIMENTATION.
   a. *Introduction.*
      (1) A statement in very general terms of some controverted point or of some unsolved problem in educational method.
      (2) A brief survey of experiments made in the same general field for the scientific determination of the value of factors in educational method and a summary of results.
      (3) Differentiation of problem proposed from any or all others attempted in the same general field—or a brief statement of reasons for resubmitting a problem to test.
   b. *Specific statement of problem so worded as to clearly define the field of the experiment and isolate the factor to be tested.*

2. SELECTION OF LABORATORY FOR EXPERIMENTATION.
   a. *Grades or groups of pupils selected and a statement of reasons for the particular choice.*
   b. *Schools chosen—because of:*
      (1) Ideal external conditions.
         (a) General character of student body.
         (b) Accessibility to experimenter.
      (2) Co-operation of supervisory officers—reasons for assuming this.

c. *Teachers in charge of grades or groups. Selected because:*
   (1) They are intelligent with reference to controlling conditions of test, in co-operation with experimenter or investigator. Precautions taken to insure this.
   (2) They have scientific attitude of mind. Reasons for believing this.
   (3) They are professionally interested in results of test.

3. CHOICE OF CONDUCTOR OF EXPERIMENT.

a. *A consideration of each of the following agents or any combination of them collaborating as best adapted to the purposes of the experiment and most likely to secure valid results.*
   (1) The investigator—why or why not?
   (2) The teacher in charge of the grade or group—why or why not?
   (3) The principal in charge of a building—why or why not?
   (4) The superintendent in charge of a system—why or why not?

b. *The agent (or agents) selected as determined by:*
   (1) Ideal desirability.
   (2) Expediency.
   (3) Necessity.

4. DEVELOPMENT OF A PROCEDURE FOR EXPERIMENT.

a. *Content—should include a full consideration of:*

(1) Difficulties encountered and plans for overcoming them. For example:

(a) Preliminary tests to find (i) the "unknown," (ii) disturbing factors, (iii) suitable subject-matter, (iv) time limits, (v) suitable laboratory, (vi) etc., etc.

(b) Preliminary conferences with school officials and teachers.

(2) Dates and days on which instruction, drills or tests may best be given.

(3) Time of day when presentations, drills or tests may best be given.

(4) Subject-matter to be used as basis of instruction, drills or tests.

(5) Details of procedure proposed for experimenter or his assistants in conducting the experiment. For example:

(a) Copies of instruction to be given to helpers with statement of precautions to be observed.

(b) Time limits fixed for periods of instruction, drills or tests—with precautions to be observed.

(c) Form, order and method of giving directions to group to be tested. Precautions to be observed.

(d) Record to be made of (i) interruptions to attention of class or of any considerable number of students by visitors, messengers, storm or rain, accident, discipline, etc.; (ii) weather conditions during each successive period of presentations, drills or tests; (iii) temperature of laboratory (classroom), (iv) condition of ventilation, (v) missteps in carrying out instructions by slight or considerable variations in form of a definitely-planned procedure, as, for instance, the inversion of order or the varying pronunciation of words.

b. *Form—A statement in full detail and in order of steps to be taken in the preparation and presentation of material of test and in full conduct of experiment.*

5. CONDUCTING OF EXPERIMENT.
   a. *Under conditions agreed upon with such slight modifications only as are made necessary by exigencies of a given situation.*
   b. *Full, detailed and explicit record—at the time—of all variations from authorized procedure, together with any observations which might reveal presence of varying factors.*

6. REVIEW OF EXPERIMENT AND PRELIMINARY REPORT.
   a. *A full statement by experimenter and assistants—in person, when possible—to Seminar of all information, whether recorded or not, which has bearing direct or remote upon interpretation of results and validity of same.*
   b. *Tentative outline of scheme for tabulation of data with suggestions as to possible or significant correlations to be found, diagrams to be made, and points to be emphasized in formal report for publication.*

7. FORMAL REPORT AND PUBLICATION.
   a. *Preparation of report by individual or committee.*
   b. *Principles governing form of report as determined by the uses to which it is to be put.*
      (1) The abstract.
      (2) The summary.
      (3) The detailed report.

c. *Review, criticism and, if need be, complete or partial revision by Seminar.*

d. *Dissemination of the several kinds of reports by most effective and economical means, so as to hasten the development of a science of educational method and favorably affect current educational practice.*

VI. Development of Outline

The sub-heading given to the outline just presented is indicative of the uses to which it is intended it should be put. A little further development of it may make this clearer, and may render it more serviceable as a manual, by no means complete, but nevertheless quite suggestive and, therefore, useful to the members of a seminar in educational research. No separate comment will be made on the less significant subdivisions. The separate sections designated by a, b and c, respectively, will correspond to the two or three principal subdivisions under each of the seven main topics in the outline.

1. Formulation of a problem for experimentation. a. In any meeting of educators where the topics appointed for consideration are open to free discussion by men representing various types of training and experience it frequently happens that two successive speakers discussing problems of educational method earnestly contend for the superiority of one procedure or practice over another with a

dogmatism and in a form of dialectic which would have done credit to the scholastics of the Middle Ages. The discussion is usually futile. The literature of methodology is largely made up of the same kind of interminable controversy over points which have never been scientifically determined. Almost any one of these is sufficiently important, from the standpoint of educational economy, to justify investigation. The more important of these will, therefore, furnish problems which the seminar may undertake to formulate and solve. And until some scientific society has formulated the general problem of educational method and isolated for separate tests the numerous factors involved, or has gone this far with a group of educational activities or interests closely associated, we can have no better starting point in the development of a science of method than to undertake, under the most favorable conditions, to settle one of these fruitless controversies.

Before any considerable amount of labor has been expended upon such a problem, however, it would be well to make a more or less careful survey of any previous contributions made toward its solution and scientific determination. If no study covering the same specific topic of inquiry has been published, or made easily available, then the field is open for such a study. If previous experimentation has taken place and the results are, from any cause, not conclusive or not well worked out, or if no adequate record has been left to indicate conditions main-

tained during experimentation, or if the test was not applied to a sufficiently large number of pupils, or if for any other good reason the validity of conclusions is called into question, there may be ample justification for resubmitting the problem to test under conditions which will be likely to measurably strengthen the scientific value of results. All this preliminary investigation and research may be made by some individual member of the seminar who has a special interest in the particular problem or by an individual or committee appointed by the seminar to do so.

b. The specific, definite and technical statement of the problem should then be undertaken. This statement must be so worded as to be absolutely clear. The certain isolation of a single factor to be tested will constitute one of the most difficult, if not the most difficult, of the tasks the group of scientists will have to perform. This calls, therefore, for the best judgment of all, and if the final formulation of the problem is the outcome of serious group deliberation, the result, in the course of experimentation, will amply demonstrate the superiority of seminar collaboration over individual effort.

2. Selection of laboratory for experimentation. a. There are obvious reasons why certain kinds of problems in scientific method may best be submitted to test in the grades or groups where the results may be specifically applicable in the improvement of classroom teaching procedures.

b. Great caution must be observed by the seminar in the selection of a school system which is to serve as a laboratory for experimentation. Ideal external conditions may not easily be found, but their importance to the success of the experiment is all but determing. A student body should and can be found which conforms closely to a normal group type, in age, in grade, in social class, in mentality, etc. Theoretically, there may be little importance attached to the location of a school in which experimentation is to take place. Practically, it is a matter of great importance that a school be chosen, when possible, which is readily accessible to the conductor of the experiment. The full and intelligent co-operation of the supervisory officers is a matter of first importance. It may not be readily assumed. Considerations, political, professional or personal, may render it either inexpedient or impossible for a school principal or a superintendent in a given case to provide such conditions as are necessary for successful experimentation.

c. It is conceivable, theoretically, and it is known to be true in practice, that in some schools where suitable grades or groups are available, where external conditions are all that could be desired, and where complete and intelligent official co-operation on the part of supervisory officers is assured, the attitude of one or more individual teachers may easily defeat the purpose of the experiment. A school should, therefore, be chosen in which the

teachers who are in charge of the grades or groups to be used in an experiment are intelligent with reference to controlling and keeping uniform the conditions of the test in exact conformity to the wishes of the experimenter. This presupposes tact and good judgment, a keen and alert intellect, power to concentrate quietly on almost infinite detail, unfaltering honesty of purpose, unquestioned frankness and truthfulness, a scientific attitude of mind and a professional as distinct from a personal interest in the outcome of the experiment. A year's training in such a seminar in educational research as is here proposed would doubtless give, in most cases, ample assurance that the individual teacher who had enjoyed these advantages would be both able and willing to render thoughtful and intelligent co-operation.

3. Choice of conductor of experiment. a. The considerations enumerated under the first heading in this part of the full outline call for careful deliberation on the part of the seminar. In many forms of experimentation, conducted with thousands of pupils, in scores of schools, it would seem that the experimenter is perhaps the only person who is in position to adequately safeguard uniformity of procedure and of external conditions during the course of the experiment. In other forms of experimentation the teacher in charge of the grade or group may be the ideal person to conduct the experiment, and this is especially likely to be the case when the experiment takes on the procedures of the regular

classroom work. There are still other forms of experimentation in which the principal or the superintendent is best suited to the task of maintaining uniformity; but this is very infrequently the case for numerous reasons which are at once obvious; and it is usually a matter of doubtful propriety also to add to the onerous duties of either of these officials any extra burdens even when they are willing to render the service.

b. When the seminar has fully canvassed the ideal desirability of this, that or the other person, in individual or official relation to the student groups who are to be the subjects of experimentation, it may often be either expedient or actually necessary to agree upon some other agent to carry out the procedure. In so far as this arrangement is likely to introduce varying conditions, they must be recorded and taken into account in writing up the report and in framing the conclusions of the experiment.

4. Development of procedure for experiment. a. The content of the procedure which it will be seen from the outline covers many subdivisions—though this outline of them is by no means complete or exhaustive—will call for more extended and detailed discussion in the seminar group before the actual work of experimentation is undertaken than all other points suggested for preliminary consideration. A select bibliography in educational psychology will be definitely helpful in determining many of these

details. Complete stenographic notes on all these discussions and complete memoranda of book references and authorities quoted will prove of great value in preparing, in full detail, any draft of procedure agreed upon, and they may also prove of inestimable value later in writing up the report for publication. Such notes should be permanently filed—if not printed—for the ready reference of subsequent investigators of these or closely-allied problems in educational method.

b. The person selected to conduct the experiment, that is, to apply the procedures agreed upon to the concrete conditions of the classroom, whether he be a member of the seminar or some other person designated to carry on the work, should, in no case, undertake the experiment until the seminar has approved a full draft of the procedures to be carried out. And if the slightest variation is made necessary by conditions beyond his control, that variation should be recorded in detail and reported to the seminar for consideration in connection with the formulation of conclusions for publication.

5. *Conducting of experiment.* a. It frequently happens that, notwithstanding the strict observance of all possible precautions, unforseen interruptions to the progress of an experiment may occur. This is even more likely to happen in experiments for the scientific determination of educational method than in experiments conducted in the laboratory of physics or chemistry or physiological psychology.

When it does happen, the experience and discretion of the person in charge of the experimentation will enable him to decide whether or not the interruption is such as to render further progress with the experiment useless. If he decides this in the negative, he should make full record of the nature of the disturbance. If he decides it in the affirmative, it is almost equally important that a report to the seminar should be made and recorded in sufficient detail to render the experience useful as a precaution in all similar and subsequent experimentation.

b. In spite of all preliminary seminar discussion of the prerequisites of successful experimentation, the external conditions of experimentation in the field of educational method are as yet so little subject to the control of the educational scientist that the getting of valid results may be absolutely dependent, not only upon the care with which he records variations from predetermined procedures, but also upon his making, at the time, such other observations as may throw light upon individual or group variation in the character of data gathered from a given experiment. It is scarcely necessary to suggest also that attention to these details may yield important by-products in the form of closer analysis of the factors in method not yet completely isolated or thoroughly disassociated from others of a similar nature, and will, therefore, contribute more or less directly to the success of all subsequent experimentation in educational method, and, finally, to

the development of vital as distinct from merely formal tests of teaching efficiency.

6. Review of experiment and preliminary report. a. On such points as those discussed in paragraphs *a* and *b* under the previous heading, the seminar in full session should be given the completest possible information. That is to say, the actual conditions of experimentation as they existed at the time of and throughout the whole period of the experiment should be reproduced by oral or by more formal report in the most concrete and vivid manner possible. This report should be given to the seminar before any attempt is made to formulate the conclusions of the experiment for publication. If anything like a general concensus of opinion, supported by the best published authority, can be arrived at by the seminar as to the probable bearing of each and all of the successive steps taken in the course of the experiment upon the result sought then the conclusions ought to carry more weight in the readjustment or confirmation of current practice in educational method. If no such consensus of agreement can be arrived at then any report for publication, stating the conclusions justified by the experiment, can be framed with due caution as to the purely tentative character of these conclusions. There will then be no substitution of invididual opinion for scientific results. And again, let it be remembered that it is against just this that the seminar must sit in unyielding protest if it is to amply justify its supe-

riority over the individual worker as an agency for real, scientific achievement in the domain of educational method.

If the seminar should decide, after hearing and discussing this preliminary report, that the procedures previously worked out for the experiment were defective or incomplete or faulty, or that, from any cause, no clear conclusions would be justified, then the experimenter may be spared much fruitless labor in preparing a formal report and much expense in publishing results which might prove to be not only inconclusive, but completely misleading. There are circumstances, however, in which the seminar might be amply justified in undertaking to formulate a clear-cut report on a piece of experimentation which, from one cause or another, could not be carried to successful issue. This may result, if well done, in closing up some of the blind alleys of educational research, and, in a more constructive way, it may be helpful and suggestive in improving the procedures for and the control of the external conditions of subsequent experimentation.

b. While the procedures of a test are being worked out and during the progress of experimentation many suggestions will come to those who are actively participating in the work as to the possible bases of classification of data for tabulation and graphic representation; and even a cursory survey of the data—in their crudest form—will suggest to the person who has made the preliminary

scores an idea of possible or at least of significant correlations to be worked out. These may or may not be in line with what the seminar has had in mind in the first case as to the method, and in the second case as to the object of the study. A full discussion of these points in seminar, on the basis of an outline prepared and recommendations made by the member or members most familiar with the progress of the experiment up to this point, will bring the technical knowledge of each type of expert in the group to bear directly, and in the most effective way, upon the very difficult and laborious task of working up results for publication. Such points of discussion will likely help the person or persons designated to prepare the formal report and draft the final conclusions to keep the main purpose of the study and its direct contribution to scientific method in the proper perspective, and to give to the by-products of the study—unless they be of absorbing interest and significance—a place well in the background.

7. Formal report and publication. a. It is believed that in the case of the simpler investigations, and such as do not require extensive or technical mathematical calculations, the report may well be prepared by the individual member who has conducted, or been directly in charge of, the experiment. In all other cases the preparation of the report had better be undertaken as a work of collaboration, both for the sake of economy of time and efficiency of service. The members of such a committee

should be chosen because of their special individual preparation for each special assignment of work, and their technical skill and experience in rendering such service. For instance, the member who can describe with nicety of diction, with brevity, and with absolute clearness as to all the scientific distinctions which are called for the details of procedure may best undertake this task, and in doing so may make an invaluable contribution to scientific accuracy. The more difficult mathematical computations and correlations may, for obvious reasons, best be worked out by the expert statistician if there be one in the group; and inasmuch as this is a purely technical piece of work, the group or committee may do well to call in the services of such an expert in case no member of the seminar has adequate training or the time at his disposal to work out the results.

b. The form of the report may well be considered both for the sake of economy in printing and because the good uses which any scientific publication may subserve depend in some cases upon its brevity, in others upon such an orderly or conventional arrangement as will render it most effective for ready reference, and in still others upon the complete elaboration of all details of scientific interest or significance. The abstract, the summary and the full detailed report will, each in turn, serve a special use which neither of the others can serve. If all of these forms of report are included in a monograph on a single piece of experimentation, they

should be arranged in the order named. They will probably be prepared in the reverse order. Whether they are published separately, or, as above suggested, they will serve very different purposes for different classes of readers, respectively, or even for the same readers.

(*1*) *The abstract,* which is the briefest form of report, may, when it is to be used in the public press or given to teachers for the modification and improvement of method, be written up in terms of valid scientific conclusions; if for use in the general or more popular educational papers or for book reviews, or for any of the purposes of propaganda, it should give in the broadest outline a statement of the controverted point tried out by the processes of experimentation, of the procedures and conditions of the test, and of such conclusions as suggest the possibility of, and the means for, the improvement of current educational practices. The greatest caution should always be observed in writing up abstracts lest general statements, with little or no qualification, should be grossly misleading.

(*2*) *The summary* should be in the form of a work of ready reference, whether it is published under the same cover with the other forms of report or whether it is published separately. As an amplification of the abstract, it should add to its clearness, and as a synopsis of the complete report, it should eliminate mere detail. If it be written for a specific use, it may place special emphasis upon this, that

or the other feature as the purpose for which it is prepared may determine. For instance, as an article in an educational journal for a select class of more or less scientific educational thinkers, it might be so written as to emphasize the scientific aspect of the procedures of experimentation and of the conditions of test rather than other more general and more popular features. As a work of general reference for such readers as are likely to develop through it a special interest in the study of the complete detailed report or a more genuine interest in scientific educational experimentation, it should be well proportioned in its emphasis, and should correspond in sections, chapters, and subdivisions to the general report upon which it is based. Here great care must be taken to properly qualify all general statements, especially such as pertain to conclusions likely to affect current educational practice.

(*3*) *The detailed report* should give, in the most orderly form for clear comprehension, every fact or detail in connection with the whole experiment which has direct or remote scientific bearing upon the validity of conclusions proposed or upon the future development of formulas and procedures, and the control of external conditions for the scientific determination of educational method. It should include, therefore, in the case of any given experiment, all such details as are suggested in the general outline proposed on page 34 and many others directly appertaining to the particular experiment covered by

the report. Each study will, in many respects, present a case *sui generis* and no general outline of the order of treatment or of the details to be included could possibly apply, except in the most general way, to reports of the several kinds of investigations contemplated. No such outline is, therefore, attempted. In many cases the full publication of all this material would involve great expense which need not, and perhaps ought not, to be incurred. The full detailed report, however, should be made available, if only in manuscript form, to all well-accredited students of scientific educational method who wish to consult the files and records of the seminar. It might be well also to keep on file all original data, including original papers collected from students, stenographic reports of seminar discussions, notes on the conditions existing during the course of experimentation, etc. This material will have interest for a very few only, but for such it may prove invaluable, and it may obviate the necessity of much duplication of labor as well as save expense in time and money when similar investigations are in progress.

c. It is needless to suggest that if any one of these three forms of report is to represent the most scientific achievement which the seminar as a whole is capable of and is to serve the highest purposes of science, it should, after the formal draft has been prepared by the individual or committee appointed to do so, be carefully read and studied by each member of the group separately and then discussed

again in a round-table conference, and, if need be, revised or in part rewritten before going to the files or before going to the press to receive the imprint of the seminar.

d. A few suggestions may be in order as to the means by which the results of scientific inquiry into educational method may, with the least possible expense, be made most effective for the immediate improvement of educational practice and for the growth among educational thinkers of a genuine and sympathetic interest in the rapid development of a full-grown science of educational method.

Educational papers and the daily press, by the free publication of authorized abstracts—not garbled or distorted or twisted for sensational purposes—might do much to popularize the efficiency test as applied to educational method. The United States Bureau of Education might wisely use its frank for the general distribution of such approved abstracts among weekly newspapers—especially in rural communities—just as the present Commissioner is now doing in the dissemination of other information of great interest and importance to the general public.

County and city superintendents of schools might interest the more thoughtful teachers directly by occasionally incorporating a summary of one of the most important of these studies in annual reports and in recommendations to teaching groups under their immediate official supervision. The United States Bureau of Education might, by means of brief

special bulletins, bring summaries of the best of these studies to the special notice of officers of all voluntary educational associations and legally organized teachers' institutes and thus open the way for their discussion at many faculty meetings, general educational conferences and widely influential public educational gatherings. Colleges and universities might use their special mailing privileges for the wide distribution of summaries among large groups of interested educational workers.

When the publication of a full detailed report on a given study seems to be merited, either by the superiority of the report itself as an embodiment of the best developed principles and formulas for scientific inquiry into educational method, or by the conclusive nature of the results of the study for scientific uses, the expense of such publication should be borne by some one of the great educational foundations, or by the Federal Bureau of Education, or by some one of the national educational associations or scientific educational societies. These publications should then be made accessible in all university and college libraries where scientific studies of educational method are being made.

Bibliographical Note

A well classified list of studies made in this and closely allied fields of educational inquiry has been prepared by Dr. I. L. Kandel and may be found in Bulletin No. 13, 1913, issued by the United States Bureau of Education, Washington, D. C.